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TREE INJECTION AS A CONTROL OF THE MOUNTAIN PINE BEETLE IN WESTERN WHITE PINE

1937 Investigations

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TREE INJECTION AS A CONTROL OF THE MOUNTAIN PINE BEETLE IN WESTERN WHITE PINE

During the years from 1930 to 1936, experimental injections of western white pine trees have been made with various poison solutions in an attempt to destroy the broods of the mountain pine beetle which develop beneath the bark. The trees have always been injected during the summer or fall of each year and examined during the spring of the succeeding year. The results of these injections have been submitted annually in report form, so that there is no need of reviewing the work up to the present time. This report therefore deals only with the examination of trees which were injected during the fall of 1936 and examined during June 1937.

Method of Examination

Each injected tree was felled, and half-square-foot samples of bark were examined on two opposite sides of the tree at heights of 5, 20, 40, 60 feet, etc., for the total infested length of the tree. If no living broods of the mountain pine beetle were found, the entire circumference of the tree was examined at each height to ascertain if streaks of living insects were present.

The abundance of mountain pine beetle broods in uninjected trees was determined by similar examinations of untreated trees. Sufficient of these check trees were examined to constitute 15 percent of those treated. The average brood in the injected trees was then compared

with the average brood in the check trees to determine the average mortality.

General Resume of Injections and Results

A total of 155 trees were injected during the 1936 studies. These were treated with four poisons by means of a saw-kerf and different types of bands and collars. The various poisons and injection methods were discussed completely in the report of the injections made during 1936.

Table I shows the average mortality secured by the different poisons and the various types of injection.

Table I

AVERAGE MORTALITY SECURED BY VARIOUS POISONS AND TYPES OF INJECTION

Poison	Number of trees injected	Type injection	Average mortality Percent
Ammonium fluoride	11	Rubber collar	90.2
Sodium thiocyanate	6	Rubber collar	28.1
	3	Auger holes (Dry poison)	13.7
	3	Hack girdle (Dry poison)	18.1
Copper sulfate	49	Rubber collar	78.1
Zinc chloride	21	Rubber band	51.5
	48	Rubber collar	59.6
	7	Paper collar	40.4
	7	Painted tin	87.4

It is apparent in table I that ammonium fluoride yielded the highest mortality of all poisons, and sodium thiocyanate the least mortality. This should not be taken as indicating, however, that ammonium fluoride is the best poison and sodium thiocyanate the poorest, because only a few trees were injected with each poison, and it would be possible to select an equal sample among trees injected with other salts which would show equally high or low mortalities. It is also to be remembered that both sodium arsenate and copper sulfate yielded even better results when first tested on a small scale. The reason for this is that in the preliminary test of a poison only a few trees are injected, and an attempt is made to have all ages of attack equally represented. Thus a fresh attack has a value equal to an old attack. Under normal conditions, however, a greater number of older attacks are treated than fresh attacks, which gives greater opportunity for low mortality when the poison is tested on a large scale. It is believed that when a new poison is to be tested it should be used on a scale equal to that of the other poisons so that a fair comparison may be had.

Table II shows the differences which may occur in injected trees, even though the greatest care is exercised in an attempt to keep all variable factors equal for each group.

Table II

AVERAGE OF PROBABLE IMPORTANT VARIABLE FACTORS
FOR EACH POISON AND TYPE OF INJECTION

Poison	Type of injection	Number of trees	Average: Rings last 1/2 in. Number	Age of attack Days	Depth saw-kerf Inches	Depth blue stain Inches	Mortality Percent
Ammonium fluoride	Rubber collar	11	19	46	.36	.36	90.2
Copper sulfate	Rubber collar	49	18	57	.27	.57	78.1
	Rubber collar	46	14	59	.26	.71	59.6
Zinc chloride	Rubber band	19	22	63	.30	.74	51.5
	Painted tin	7	28	73	.33	.72	87.4

It is apparent in table II that ammonium fluoride had the advantage of younger attacks, deeper saw-kerf, and least blue stain at the point of injection. It is again obvious, as in the 1934 studies, that it is unwise to attempt to solve too many problems with one season's work.

Effect of Depth of Saw-kerf on Mortality

Table III shows the average mortality which resulted in different age-of-attack groupings according to the depth of the saw-kerf.

Table III

AVERAGE MORTALITY ACCORDING TO AGE OF ATTACK AND AND DEPTH OF SAW-KERF

Poison	Age of attack	Depth of saw-kerf in inches .1 - .4	.5 - .8
	Days		
Copper sulfate	26-50	75	71
	51-75	80	88
	76-100	77	94
Zinc chloride	26-50	70	70
	51-75	59	100
	76-100	45	37

Although other factors enter to cause irregularities in the mortality averages, there is an apparent tendency for deeper saw cuts to be more effective when the tree has been attacked for a longer period of time. This is particularly noticeable in the deeper saw-cut trees which were injected with copper sulfate. It was thought that with the older attacks, where greater blue-stain development had occurred, a deeper saw-kerf may expose more conducting tissue or may even penetrate to unblued sapwood. It is planned to conduct tests to secure more information on this point.

Table IV shows the effect of depth of blue stain and saw-kerf on mortality.

Table IV

AVERAGE MORTALITY ACCORDING TO THE DEPTH OF BLUE STAIN AND SAW-KERF

Blue stain depth Inches	Saw-kerf depth in inches .1 - .49	.5 +
0	89	90
.1 - .29	93	
.3 - .49	66	65
.5 - .69	53	59
.7 +	42	

In table IV no apparent relationship exists between the depth of blue stain and the depth of the saw cut. Obviously, if the depth of the saw cut plays an important part in tree injection, then there should be a definite relationship shown when the saw cut penetrates beyond the blue stain and should be apparent in table IV.

It is believed that one of the major factors which obtained to cause so much variation in the 1936 injections was the heavy dosages used. The copper sulfate solutions used during this project were close to the saturation point, and it was noticed that there was considerable crystallization in the bottom of some of the collars. This crystallization probably resulted from evaporation of water from collars on trees which were conducting the solution slowly. In any event, it is believed that considerable blocking of tracheids occurred in this manner and resulted in such variable mortalities for seemingly no reason.

Effect of Obstructed Sapwood on Mortality

Table V shows the average mortality secured on the basis of the amount of sapwood unobstructed by blue stain at the point of injection.

Table V

AVERAGE MORTALITY SECURED ACCORDING TO DEPTH OF BLUE STAIN AND WIDTH OF SAPWOOD

Depth blue stain	Width sapwood in inches			
Inches	0 - .49	.5 - .99	1.0 - 1.49	1.5 - 2.0
0 - .49	46	87	82	82
.5 - .99		44	57	86
1.0 -1.49			29	60
1.5 -2.0				37

Table V shows that where blue stain has not completely obstructed the sapwood, mortality is greater, and that there is a slight tendency for the greatest amount of unobstructed sapwood to show the greatest mortality.

Effect of Rate of Growth on Mortality

In reporting on results of the 1935 injections it was shown that an apparent relationship existed between the rate of tree growth and the amount of mortality. The correlation indicated that the slower-growing trees apparently yielded higher mortalities, and the theory was advanced that the denser, slower-growing wood offered more resistance to blue-stain development.

Table VI shows the average mortality secured for all dosages according to the number of rings in the last half inch of wood.

Table VI

AVERAGE MORTALITY ACCORDING TO RATE OF TREE GROWTH

	No. rings last half inch					
	0-5	6-10	11-15	16-20	21-25	26+
Percent	80	74	45	74	73	67
average mortality	74		58		70	

It is obvious in table VI that no apparent relationship exists between the mortality secured in the 1936 injections and the rate of tree growth.

Table VII shows the average mortality according to depth of blue stain and rate of tree growth.

Table VII

AVERAGE MORTALITY ACCORDING TO RATE OF GROWTH AND DEPTH OF BLUE STAIN

Rings last half inch	Depth of blue stain in inches			
	0 - .49	.5 - .99	1.0 - 1.49	1.5 - 2.0
Number				
1-10	85	56	52	87
11-20	65	60	46	45
21-30	77	71	39	64
31+	73	88		

Table VII shows that rate of tree growth had no apparent effect upon the success of the 1936 injections.

Summary and Conclusions

The results of the 1936 injections are disappointing as a whole and yield no definite positive correlations. The main conclusion to be drawn from this project is to avoid trying to solve too many problems with limited facilities and resultant small samples. Previous reports show that greatest advances were made with this work in 1933 and 1935 when a large number of trees were injected with but one objective in view, while poorest results were secured in 1934 and 1936 when numerous poisons and techniques were tested.

It is believed that in addition to the inadequate number of trees representing each variable, the results were still further complicated by the attempt to inject heavily blue-stained trees with large dosages of poison. As a result of the slow conduction by these trees, water evaporated from the collar and the saw-kerf was blocked by a deposition of the solid poison as it came out of solution.

Recommendations for the 1937 Project

The 1937 project should concentrate entirely upon ascertaining the proper dosage of copper sulfate to be used for bark-beetle control purposes. It is recommended that this be done by using various concentrations of solution and injecting different quantities of these various concentrations on the basis of tree diameter.

Once a satisfactory control method has been established, other poisons, methods of injection, etc. can be properly tested.